UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2014/2015 Academic Session

June 2015

EBP 324/3 – Polymer Degradation and Environment
[Degradasi Polimer dan Alam Sekitar]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains EIGHT printed pages before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. THREE questions in PART A and FOUR questions in PART B.
[Kertas soalan ini mengandungi TUJUH soalan. TIGA soalan di BAHAGIAN A dan EMPAT soalan di BAHAGIAN B.]

Instruction: Answer **FIVE** questions. Answer **ALL** questions from PART A and **TWO** questions from PART B. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.
*[**Arahan**: Jawab **LIMA** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A dan **DUA** soalan dari BAHAGIAN B. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

The answers to all questions must start on a new page.
[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies in the examination questions, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

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PART A / *BAHAGIAN A*

1. [a] Discuss Bolland Gee auto-oxidation reaction.

Bincangkan tindakbalas auto-pengoksidaan Bolland Gee.

(60 marks/*markah*)

[b] Describe the role of chromophores in photo-degradation of polymer.

Huraikan peranan kromofor dalam perosotan foto bagi polimer.

(40 marks/*markah*)

2. [a] Figure 1 shows the various recycling technique which can be used to recycle polystyrene.

Rajah 1 menunjukkan pelbagai kaedah kitar semula yang boleh dilakukan untuk mengitar semula polistirena.

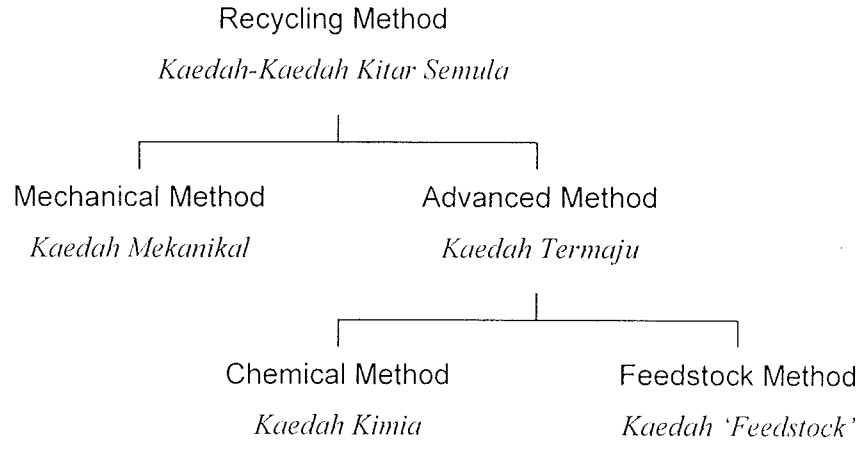

Figure 1

Rajah 1

Discuss the advantages of Advanced Method as compared to Mechanical Method to recycle polystyrene.

Jelaskan kelebihan Kaedah Termaju berbanding Kaedah Mekanikal untuk mengitar semula polistirena.

(50 marks/*markah*)

[b] State 10 benefits of expanded polystyrene (EPS).

Nyatakan 10 kelebihan polistirena terkembang (EPS).

(30 marks/*markah*)

[c] State 4 reasons why we need to recycle polyvinyl chloride (PVC).

Nyatakan 4 alasan mengapa kita perlu mengitar semula polivinil klorida.

(20 marks/*markah*)

3. [a] One biodegradable plastic product has been thrown away in the ocean and the other one has been thrown away in the landfill. Compare and explain the degradation process in both places by taking into account on few parameters that will influence the degradation process. In which place the degradation process will occur faster and why?

Satu produk plastik terbiorosot telah dibuang ke dalam laut dan satu lagi dibuang di tempat pembuangan sampah. Banding dan jelaskan proses perosotan di kedua-dua tempat dengan mengambilkira beberapa parameter yang akan mempengaruhi proses perosotan. Di tempat manakah proses perosotan akan berlaku lebih cepat dan mengapa?

(30 marks/*markah*)

[b] De-polymerization process for biodegradable polymers normally occurs outside of the micro-organisms. Explain. Is there any exception for that statement?

Proses penyahpolimeran untuk polimer terbiorosot biasanya berlaku di luar mikro-organisma tersebut. Jelaskan. Adakah sebarang pengecualian terhadap pernyataan tersebut?

(30 marks/*markah*)

[c] Which method is better between recycling and reuse of plastic? List and explain three (3) reasons why plastic materials need to be recycled.

Kaedah manakah yang lebih baik di antara mengitar semula plastik dan menggunakan semula plastik? Senaraikan dan jelaskan tiga (3) sebab mengapa bahan plastik perlu dikitar semula.

(40 marks/*markah*)

PART B / *BAHAGIAN B*

4. [a] Explain the mechanism of the following antioxidant:

(i) butylated hydroxyl toluene

(ii) thioether

Jelaskan mekanisme antioksidan berikut:

(i) toluena hidroksil terbutil

(ii) 'thioeter'

(60 marks/*markah*)

[b] Discuss the accelerated weathering tests.

Bincangkan ujian pencuacaan terpecut.

(40 marks/*markah*)

5. [a] Contamination limits the ultimate marketability of the full range of PET plastic containers collected by local recycling programs. Give your comments.

Pencemaran menghadkan kebolehpasaran akhir bekas plastik PET yang dipungut melalui program pengitaran semula pihak tempatan pada skala besar. Beri komen anda.

(50 marks/*markah*)

[b] What are the advantages and disadvantages of Melt Reprocessing of PET?

Apakah kelebihan dan kekurangan Pemprosesan Semula PET secara leburan?

(30 marks/*markah*)

[c] Discuss the main applications for mechanically recycled PET.

Bincangkan kegunaan-kegunaan utama PET yang dikitar semula secara mekanikal?

(20 marks/*markah*)

6. [a] Recycling is a four-part exercise which involve different steps to make sure that the plastics waste can be converted to new product. Discuss each step by giving suitable example. Which step is the most crucial and why?

Pengedarulangan ialah proses empat bahagian yang melibatkan pelbagai langkah untuk memastikan bahan buangan plastik dapat diubah menjadi produk baru. Bincangkan setiap bahagian dengan memberikan contoh yang sesuai. Langkah yang manakah paling penting dan mengapa?

(30 marks/*markah*)

[b] You are given two types of materials namely polyethylene (PE) and polystyrene (PS). Suggest and explain two (2) suitable cutting methods for each of the polymeric materials.

Anda diberikan dua jenis bahan iaitu polietilena (PE) dan polistirena (PS). Cadangkan dan jelaskan dua (2) kaedah pemotongan yang sesuai untuk setiap satu bahan plastik ini.

(40 marks/*markah*)

[c] (i) What is the importance of agglomeration process in polymer recycling?

Apakah kepentingan proses pengaglomeratan dalam pengedarulangan plastik?

(ii) Discuss the differences between agitation and densifying discs process and advantages of each process.

Bincangkan perbezaan antara proses 'agitation' dan 'densifying discs' dan kelebihan setiap proses.

(30 marks/*markah*)

7. [a] Describe excited state quencher.

Huraikan 'excited state quencher'.

(35 marks/*markah*)

[b] Unlike commodity plastics, the recycling of engineering plastics is economically attractive. Give your comments.

Tidak sebagaimana plastik komoditi, pengitaran semula plastik kejuruteraan adalah menarik dari segi ekonomi. Beri komen anda.

(35 marks/*markah*)

[c] Discuss briefly three (3) basic processes of pulverization methods which are:

(i) turbo rotor pulverization

(ii) hammer mills

(iii) cryogenic pulverization

Bincangkan secara ringkas tiga (3) proses asas kaedah 'pulverization' iaitu:

(i) 'turbo rotor pulverization'

(ii) 'hammer mills'

(iii) 'cryogenic pulverization'

(30 marks/*markah*)

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